

Conservation Assessment
for the
Turk's-cap Lily
(*Lilium superbum* L.)



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Lilium superbum L., from Delaware Wildflowers website. Photographer: David G. Smith, copyright 2001.

<http://www.delawarewildflowers.org/1159.html>

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

Table of Contents

Acknowledgments.....	4
Executive Summary.....	5
Nomenclature and Taxonomy.....	6
Description of the Species.....	7
Habitat and Ecology.....	8
Distribution and Abundance.....	10
Protection Status.....	13
Life History.....	14
Population Biology and Viability.....	15
Potential Threats.....	16
Research and Monitoring.....	19
Restoration.....	21
Summary.....	23
References.....	24
Websites Consulted.....	27
Contacts.....	28
Appendix 1. Representative specimens of <i>Lilium superbum</i> examined or cited in the literature.....	30
Appendix 2. The distribution of <i>Lilium superbum</i> in the United States. Information from herbarium specimens and the literature.....	32
Appendix 3. Natural Diversity Database Element Ranking System.....	34

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EXECUTIVE SUMMARY

This Conservation Assessment is a review of the taxonomy, distribution, habitat, ecology, and status of the Turk's-cap Lily, *Lilium superbum* L., throughout the United States, and in the U.S.D.A. Forest Service lands, Eastern Region (Region 9), in particular. This document also serves to update knowledge about potential threats and conservation efforts regarding the Turk's-cap Lily to date. *Lilium superbum* is a perennial herb from a rhizomatous bulb with a single stem about 1.2-2 meters tall with whorled narrowly elliptic leaves and showy red-orange pendent terminal flowers. The species is widespread in the eastern United States and it is known historically from twenty-six states including the District of Columbia, from New Hampshire west to Illinois and Missouri, south to Louisiana and Florida. It is a species often associated with wetlands or the margins of mesic upland forests and it grows in soils that are often acidic. Globally, its ranking is G5 (secure world-wide); its National status in the United States is NNR (not ranked nationally). The Turk's-cap Lily is listed as Endangered in New Hampshire (S1), and as Threatened in Kentucky (S1S2). It has been ranked as Critically Imperiled (S1) in Arkansas, Florida, Louisiana, and Missouri, and it is listed as a species that is Exploitably Vulnerable in New York. It is considered Imperiled (S2) in Alabama and Illinois and Vulnerable (S3) in Indiana, Mississippi and Ohio and slightly less so in Georgia (S3S4). In Forest Service Region 9, the Turk's-cap Lily is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest but not the Hoosier National Forest. It is at risk at the margins of its range

In addition to species listed as endangered or threatened under the Endangered Species Act (ESA), or species of Concern by U.S. Fish and Wildlife Service, the Forest Service lists species that are Sensitive within each region (RFSS). The National Forest Management Act and U.S. Forest Service policy require that National Forest System land be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the entity throughout its range within a given planning area.

The objectives of this document are to:

- Provide an overview of the current scientific knowledge on the species.
- Provide a summary of the distribution and status on the species range-wide and within the Eastern Region of the Forest Service, in particular.
- Provide the available background information needed to prepare a subsequent Conservation Approach.

NOMENCLATURE AND TAXONOMY

Scientific Name: *Lilium superbum* L. [1762]

Common Names: Turk's-cap Lily, Swamp Lily, Superb Lily, American Turk's-cap Lily

Synonymy: *Lilium canadense* L. ssp. *superbum* (L.) Baker (1871)

Lilium fortunofulgidum Roane & J.N.Henry (1980)

Lilium gazarubrum Roane & J.N.Henry (1980)

Lilium mary-henryae Roane & J.N.Henry (1980)

Class: Liliopsida (Flowering Plants - Monocotyledons)

Family: Liliaceae (The Lily Family)

Plants Code: LISU (U.S.D.A. NRCS plant database, W-1)

<http://plants.usda.gov/>

The genus *Lilium* L. contains about 100 species worldwide, 21 of which are native to North America (Skinner 2002). The genus is most common in the temperate Northern Hemisphere, and it extends south to the mountains of the Asian tropics. The true lilies are most diverse in eastern Asia (60 species) and North America, and they are thought to have arisen in eastern Asia. They are most common in mountainous regions. In North America, they can be found in very diverse habitats, including wet pine flatwoods and savannas, bogs, tallgrass prairies, open woods, thickets, barrens, mountain meadows, oak canyons, and chaparral to name a few, from 0 – 2,900 meters in elevation. The genus is most closely related to the East Asian genera *Fritillaria* L. (a genus also found elsewhere)), *Nomocharis* Franchet, *Notholirion* Wallich ex Boissier, and *Cardiocrinum* (Endlicher) Lindley. There are several distinct groups within the genus *Lilium*, including one group with erect flowers and well-developed nectar guides (e.g., *Lilium philadelphicum*), two groups in western North America (e.g., *Lilium columbianum*, *Lilium pardalinum*), and two groups of pendent-flowered eastern lilies, the first a southeastern group with buds triangular in cross section that also have sepals with two longitudinal ridges (e.g., *Lilium superbum*), and the second a more northern group with roughened leaves, yellowish bulbs, and red styles (e.g., *Lilium canadense* L.). An infrageneric classification is not yet available (Skinner 2002). The name *Lilium* was derived from the Greek *lirion*, meaning a white lily. The members of this genus have been treasured since pre-historic times by humans for their beauty and commercial value – lilies have been cultivated, eaten, and used medicinally in areas such as China for at least 2000 years (Haw 1986).

The Turk's-cap Lily was first named by Linnaeus [in 1762], who used the Latin epithet '*superbum*', equivalent to the English 'superb' or 'splendid', to describe its very decorative appearance (pronounced *superb'-um* – and not *sup'er-bum* as some of my former students believed!). It is in the group loosely defined above as the pendent-flowered eastern lilies, and in the subgroup of eastern and southeastern North American species with flower buds that are triangular in cross section and sepals with two outer (abaxial) longitudinal ridges. The other

species in this group considered to be close relatives of *Lilium superbum* are *Lilium iridollae* M.G.Henry, *Lilium pyrophilum* M.W.Skinner & Sorrie, and *Lilium michauxii* Poiret. Slightly less closely related, in the rough-leaved group, are *Lilium michiganense* Farwell, *Lilium canadense* L., and *Lilium grayi* S.Watson (Skinner 2002). There has been some taxonomic and identification confusion among these species. Studies have suggested that *Lilium pyrophilum* and *Lilium iridollae* may be geographic isolates very closely related to *Lilium superbum* (Skinner 2002). No subspecies or varieties are currently accepted within the species. While hybrids may occur in areas of overlapping range, none are currently accepted or named (Skinner 2002).

The common name Turk's-cap Lily is generally used and accepted as the common name for this plant. This name is based upon a fancied resemblance to the highly decorative red caps worn by some Turks in the 1700's, and the name was also applied to several similarly decorative plants such as the Turk's-cap mallow (*Malvaviscus*) and the Turk's-cap cactus (*Melocactus*), as well as this lily, named during that period. A few other names for this lily occasionally appear in the literature, namely, Swamp lily, and Superb lily (Yatskievych 1999).

DESCRIPTION OF THE SPECIES

Lilium superbum, the Turk's-cap Lily, is a somewhat soft-fleshy perennial herb with 2 (-3) white scaly bulbs 2.4-4.3 cm x 6-10.2 cm that are odorless and rhizomatous (the bulbs are often separated from each other by pale rhizomes 0.6-3.8 (-4.6) cm, these often branching dichotomously); its erect **stems** usually have roots above the bulbs and are unbranched, (60-) 120-200 (-280) cm tall, green, and glabrous. The sessile **leaves** are (4-) 7.1-17 (-26.1) cm long x 0.7-2.7 cm wide, 4-18 times longer than wide, and are mostly numerous, evenly distributed, and whorled in several (6-24) whorls - each with 3-20 horizontal leaves with drooping tips, but these are sometimes alternate at the lowermost or uppermost nodes, and they are lanceolate to narrowly elliptic, tapered at both ends, smooth, lacking any tooth-like or jagged sculpturing along the margins and veins, and at most slightly and minutely papillose along the margins. **Inflorescences** are whorls of 2-5 large showy flowers (up to 22 flowers have been recorded in cultivated plants), often reduced to a single flower in younger plants or those in less suitable habitats; flower buds are more-or-less triangular in cross section. The **flowers** are nodding and not fragrant; the stalks are bent abruptly downward near the tips. The six **sepals and petals** are similar in appearance (= tepals), 6.8-10.5 cm x 1.1-2.6 cm wide, yellow orange to red orange with purple or brownish-purple spots and are recurved, not distinctly clawed [abruptly narrowed at base], with a green area (the nectary) 11-17 mm long at the base (the six forming a visible green star). The sepals have 2 parallel, often faint abaxial ridges. The six **stamens** with the purplish 1.4-2.6 cm anthers are 15-25 mm long, strongly exerted, and the filaments are arched away from the style. The single **style** is pale green, often spotted with purple. The **fruits** are capsules 3.0-5.5 (-6.2) cm long x 1.7-2.5 cm wide, 1.7-3.3 times longer than wide; the numerous seeds are light brown, verrucose, and flattened into a 60 ° wedge. The **chromosome number** is $2n = 24$. (Adapted from Yatskievych 1999 and Skinner 2002).

The Turk's-cap Lily is the largest lily east of the Rocky Mountains. Flowers on northern plants are sometimes conspicuously colored with dark purple bases on the perianth parts. It is normally recognized and distinguished from other species by its 1-22 pendent flowers with reflexed tepals, the evenly distributed 6-24 whorls of leaves, the 2 or 3 rhizomatous white bulbs with non-scaly sections between the annual bulbs, the pale green style, the 2 faint ridges on the backs of the sepals, the flower buds that are triangular in cross section, and by the red-orange tepals. The very similar *Lilium pyrophilum* is restricted to sandhills in Virginia and the Carolinas in contrast to the much more widespread Turk's-cap Lily (Skinner 2002). In the Midwest, *Lilium superbum* has sometimes been confused with the more locally common *Lilium michiganense* (Yatskievych 1999). *Lilium michiganense* has leaf veins and margins that are noticeably roughened with tooth-like spicules (not smooth or barely papillate), the bulbs are usually yellowish (not white), the sepals are not ridged, the flower buds are rounded in cross section (not triangular), and the styles are red (not green). The two species can usually be distinguished readily by this series of vegetative and floral features.

HABITAT AND ECOLOGY

The Turk's-cap Lily has been given a national wetland indicator status of FACW or FACW+, indicating that the species usually, but not always, occurs in wetlands [FACW = Facultative Wetland, the species usually occurs in wetlands (estimated probability 67%-99%), but it can occasionally be found in non-wetlands]. In Wetland Region 3, including both Illinois and Indiana, *Lilium superbum* has been specifically designated as a NI (a No Indicator) species (Reed 1988; W-1; W-2), indicating that insufficient information is available to determine an indicator status. Overall, these habitats include gaps and openings in mesic forests, edges of mesic upland forests, swamp edges and bottoms, streamsid es, moist meadows and thickets, mountain balds, pine barrens, and roadsides from 0-1,600 meters in elevation. It appears to prefer temperate, moderate climates without hot or cold temperature extremes, and so it is relatively rare in the far northern portions of its range, the far southern parts of its range, as well as in portions of the midwest that have a continental climate with temperature extremes. It appears to be most common in the moderate and mesic climates of the central and southern Appalachian Mountains, avoiding the eastern coastal plain except in the extreme northeastern states.

A review of the literature demonstrates that this herb has a variety of plant associates and habitats throughout its range. *Lilium superbum* grows mainly in level wet meadows and swampy woodlands, though it can be found in some drier, sloping sites as well. Floras generally list the habitat of *Lilium superbum* as "Peaty meadows, swales, wet sand and swampy woods" (Fernald 1950), "wet meadows and low ground" (Gleason and Cronquist 1991), "Moist woods and thickets, wet meadows" in New England (Magee and Ahles 1999), "moist bogs, woods, and fields" in the Blue Ridge physiographic province (Georgia, North Carolina, South Carolina, Tennessee, and Virginia; Wofford 1989), "Moist or wet meadows and coves" in North and South

Carolina (Radford *et al.* 1968), and “Wet meadows, swales, swampy woodlands, coves” in the Southeastern states (Godfrey and Wooten 1981). This species tends to flower only in more open areas, and sterile stems, usually much shorter than flowering stems, predominate in more shaded habitats (Dishong 1996).

The soils where the Turk’s-cap Lily grows are normally acidic, but the species also tolerates a neutral pH; pH values of (4.5-) 5.0 – 6.5 (-7) have been recorded for the species. Some references indicate wet sands as a common habitat type, but most individuals previously known from wet sands on the piedmont of the southeast are now assigned to the species *Lilium iridollae* (Florida) or the very similar *Lilium pyrophilum* (Virginia, North Carolina, South Carolina).

In the northeastern United States, where the plants commonly grow at low elevations and nearly to sea level, *Lilium superbum* can be found in wet meadows, boggy margins of forests, swamps, and thickets. Common associates include the trees *Acer rubrum*, *Betula populifolia*, *Quercus bicolor*, and *Quercus velutina*, the shrubs *Clethra alnifolia* and *Salix* spp., the vine *Smilax glauca*, and herbs such as *Eupatorium perfoliatum*, and *Maianthemum canadense*. The Turk’s-cap Lily can occur in both disturbed secondary forests and undisturbed primary forests, and it can be locally common (W-3, pers. obs.).

In Indiana the Turk’s-cap Lily grows on “wooded slopes” in south-central Indiana (Deam 1940). It is scattered throughout much of the unglaciated hill country, and, as in Illinois, it occurs primarily as small, non-flowering colonies in upland ravines and mesic terraces along small streams in the forests (Homoya, pers. comm.). The lily grows in both well-drained soils and wetter sites that are most likely acidic. Among the associated species recorded with the Turk’s-cap Lily in Indiana are the trees *Carya ovata*, *Fraxinus americana*, *Juglans nigra*, *Liriodendron tulipifera*, and *Prunus serotina*, and herbs may include *Cacalia muhlenbergii*, *Synandra hispidula*, *Triosteum aurantiacum*, *Valeriana pauciflora*, and *Verbesina alternifolia*.

In Illinois, the Turk’s-cap Lily grows in “Low, moist woodlands” [mesic forests] and stream banks in the extreme southern tip of the state (Mohlenbrock 1986, 2002). Herbarium labels on specimens in the Illinois Natural History Survey herbarium (ILLS) included the habitats ‘Edge of a native old field’, and ‘Rich mesic upland forest with *Acer saccharum*, *Fagus grandifolia*, *Arundinaria gigantea*, *Corylus americana*, *Leersia virginica*’. Its usual associates in Illinois include the trees *Acer saccharinum*, *Acer rubrum*, *Carya cordiformis*, *Cornus florida*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, *Liriodendron tulipifera*, *Quercus alba*, *Quercus rubra*, *Quercus velutina*, *Sassafras albidum*, the introduced vine *Lonicera japonica*, the forb *Phlox paniculata*, the grass *Chasmanthium latifolium*, and the fern *Polystichum acrostichoides* (Dishong 1996). A review of the ecological status of *Lilium superbum* in Illinois, along with its taxonomy, was compiled by Dishong (1996).

In the southeastern United States *Lilium superbum* often grows in high elevation open seeps in

the southern Blue Ridge Mountains (best known in Georgia, North Carolina, Tennessee and Virginia) dominated by tall forbs (W-3). The vegetation has been classified as the *Impatiens (capensis, pallida)* – *Monarda didyma* Saturated Herbaceous Alliance (and has also been called the Rich Montane Seep, High-Elevation Type), and these small wetlands are found on upper slopes and ridgetops at elevations greater than 1200 m (4000 ft), according to the National Vegetation Classification used in the Southeastern United States (W-4). These sites lack extensive *Sphagnum* and are typically open and without a forest canopy. Characteristic species that can grow with the Turk’s-cap Lily here include the creeping shrub *Euonymus obovatus*, the forbs *Aconitum reclinatum*, *Cardamine clematitis*, *Chelone lyonii*, *Cicuta maculata*, *Claytonia caroliniana*, *Conioselinum chinense*, *Geum geniculatum*, *Helenium autumnale*, *Houstonia serpyllifolia*, *Impatiens* spp., *Lilium grayi*, *Monarda didyma*, *Senecio aureus*, *Solidago patula*, *Thalictrum clavatum*, *Trautvetteria carolinensis*, *Veratrum viride*, and *Viola* spp., as well as the sedges *Carex leptoneuria*, *Carex debilis* var. *rudgei*, and *Carex ruthii*. Another high-elevation vegetation type in which *Lilium superbum* occurs in the southeast (well-developed in the Great Smoky Mountains National Park) is the High Elevation Red Oak Forest (Tall Herb Type) (W-3; W-4). This community includes forest vegetation with a closed to very open canopy, dominated by *Quercus rubra*. Other characteristic species that can grow in this community with the Turk’s-cap Lily are the trees *Acer rubrum*, *Amelanchier arborea*, *Crataegus punctata*, *Betula alleghaniensis*, *Betula lenta*, *Halesia tetraptera*, *Hamamelis virginiana*, *Ilex montana*, and *Picea rubens*, the shrubs *Kalmia latifolia*, *Vaccinium corymbosum*, and *Vaccinium erythrocarpum*, the forbs *Ageratina altissima*, *Angelica triquinata*, *Aster acuminatus*, *Aster chlorolepis*, *Clintonia umbellulata*, *Gentianella quinquefolia*, *Laportea canadensis*, *Maianthemum racemosum*, *Medeola virginiana*, *Mitchella repens*, *Prenanthes altissima*, *Smilax herbacea*, and *Solidago curtisii*, the sedge *Carex pensylvanica*, and the ferns *Dennstaedtia punctilobula* and *Thelypteris noveboracensis*.

DISTRIBUTION AND ABUNDANCE

Lilium superbum, the Turk’s-cap Lily, is widespread in portions of the temperate eastern United States and it is known to occur historically in twenty-six states including the District of Columbia, namely, Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, and West Virginia (W-1, W-3). Several sources have included this species within Minnesota (W-1 previous versions; W-3) and Vermont (W-3) but it appears that previous reports of this species in Canada, Iowa, Minnesota, Vermont, and Wisconsin were based upon misidentified specimens of *Lilium michiganense* or another species (Adams and Dress 1982; Ownbey and Morley 1991; Allard and Popp, pers. comm., Cholewa, pers. comm.). Its inclusion in Vermont was questionable from the start – the only known reference appears to be a specimen tentatively from Chester assigned to this species by Seymour (1969). Similarly, it appears that reports in the literature (e.g., Gleason and Cronquist 1991) of

the plant in Canada are also in error. It was only recently confirmed in South Carolina (Skinner 2002). *Lilium superbum* is relatively rare in the far western, far southern, and extreme northeastern portions of its range, and becomes more common in the central Appalachian Mountains of Pennsylvania, Virginia, West Virginia and North Carolina in particular (W-3). Its range includes both formerly glaciated and unglaciated areas. As with most other species, it becomes scarce at the margins of its range. Its historic range assessed on a county basis also may have been greater than its current range. One can generally expect that a decline has occurred in recent decades because of the general loss and degradation of its natural wetland habitats nationally.

Based upon its state rankings (W-3) only, this lily would appear to be most frequent in Delaware and West Virginia (as a S5 species) and in New Jersey and North Carolina (as an S4 species). It is not ranked in eleven of the twenty-six states where it is known to occur (W-3), so its frequency cannot be precisely determined in those states. The Turk's-cap Lily is local within most of its range because of its habitat preferences, but it is considered to be common in most of its sites except in the Great Lakes region (W-3). A combination of records from several sources (see appendices) gives somewhat different results on the frequency of *Lilium superbum*. Records from floras and herbarium labels show that this herb has been found in more than 40 counties in Pennsylvania and Virginia, and in more than 15 counties in Mississippi, North Carolina, and West Virginia. In the remaining twenty-one states (including the District of Columbia) *Lilium superbum* has been found in 12 or fewer counties, though its frequency within each county varies. Additional details on the distribution of this herb can be found in Kartesz and Meacham (1999), Adams (1981, Adams and Dress (1982), and several Internet sites (e.g., W-1, W-3). Representative voucher specimens of this herb have been listed in Appendix 1. A summary of the distribution of the Turk's-cap Lily has been presented in Appendix 2.

In the east-central states, the species has been found in Illinois (where it is at its northwestern range limit in the southern tip of the state) and in Indiana, as well as in neighboring Kentucky, and Missouri, but not in Iowa or Wisconsin (W-3; Yatskievych 1999, Mohlenbrock and Ladd 1978, Deam 1940). Its current range within the United States appears to include the same states as today. It has not been listed as Extirpated (or Historic) in any state as yet (W-1, W-3).

Within the U.S. Forest Service Eastern Region (Region 9) *Lilium superbum* is known to be present within the Shawnee National Forest in Illinois, the Hoosier National Forest in Indiana, the Allegheny National Forest in Pennsylvania, and the Wayne National Forest in Ohio (and probably others). It is more common in the Southern Region (Region 8) and has been reported from the Chattahoochee National Forest in Georgia, the Ozark National Forest in Arkansas, the Pisgah National Forest in North Carolina, the Cherokee National Forest in Tennessee, the Jefferson National Forest in Virginia, and, undoubtedly, others, as well as in the Great Smoky Mountains and Shenandoah National Parks.

In Illinois, *Lilium superbum* has been removed from the list of Endangered and Threatened species, but it was listed as Endangered as recently as 1991 (Herkert 1991). By 1998 it was thought to be too common to remain on the list (Taft, pers. comm.). The species has been reported historically in Gallatin, Hardin, Jackson, Johnson, Pope, Union, and Williamson counties (W-1; Herkert 1991, Mohlenbrock 1986, 2002; Mohlenbrock and Ladd 1978; Shawnee National Forest 2005; herbarium specimen) but the references do not all agree on its county distribution. Its current distribution, as far as is known, has not changed. Within and near the Shawnee National Forest it is found within the Lusk Creek Canyon, Jackson Hollow, Bell Smith Springs, Martha's Woods, Hayes Creek/Fox Den Creek, Simpson Township Barrens, and Bulge Hole Ecological Areas, the Ozark Hill Prairie Research Area, the east branch of Cedar Creek, at Iron Furnace, along a tributary of Big Creek, at the Lake Kinkaid area, near Beaver Creek, on private land near Caney Creek, at The Nature Conservancy's Gibbons Creek area, at state land at Lake Murphysboro, and on U.S. Fish and Wildlife land at Devil's Kitchen Dam (Shawnee National Forest 2005). Few flowering individuals are ever seen in Illinois, and the plants remain in a juvenile stage likely due to shading. These sites are located within the Shawnee Hills Natural Division, primarily in the Greater Shawnee Hills Section but also in the Lesser Shawnee Hills Section of Illinois (Schwegman *et al.* 1973).

In Indiana, the state's Heritage Program previously tracked *Lilium superbum* but it is presently thought to be too common and is no longer tracked (Homoya, pers. comm.). It has been reported in Brown, Clark, Crawford, Fayette, Greene, Lawrence, Morgan and Washington counties, including several sites with the Hoosier National Forest, in the southern half of the state (W-1; Deam 1940; Homoya, pers. comm.). Almost all (if not all) of the plants are in the Shawnee Hills Natural Region and Highland Rim Natural Region. The Fayette County occurrence may be erroneous. If not, it could be in either the Central Till Plain, or Bluegrass Natural Region (Homoya, pers. comm.).

The populations of this herb in Illinois and other areas of the Midwest are scattered widely and the populations are isolated from one another. It is possible that the species was somewhat more common in the region at the time of European settlement, but there is no direct evidence for this because there are few early herbarium records from the region. Most of our current records have been found within the last two decades. The forests in the region are thought to have been kept open by means of fires set by the earlier inhabitants in the area before European settlement, and there is good evidence that *Lilium superbum* reproduces far better in open forest areas (Adams 2001, Adams and Dress 1982; Dishong 1996; Shawnee National Forest 2005). The suppression of fires later may have led to a decline in the number of populations. However, it is also likely that some open moist woodlands where it may have occurred have been developed or disturbed by agriculture and housing in the past 200 years, in which case there may have been a significant population decline as well for that reason.

There is some data available on population sizes for this herb, but herbarium label data rarely

include its local frequency or abundance. This lily is often locally common when moist soil and nearly full sun are both available (it likes ‘shaded wet feet and sunny tops’), but most Illinois populations are found in shade and the number of individuals can be small. According to personnel at the Shawnee National Forest (2005), 51 flowering individuals and 147 juveniles appeared in a 200 square meter area where a clear cut took place on private property during June 1991. Studies by Dishong (1996) indicated that in eight southern Illinois sites for the Turk’s-cap Lily, there were an average of 407 plants per site (ranging from 19 – 1,365). In portions of its range where it is frequent, populations of about 500 individuals are not uncommon.

PROTECTION STATUS

The Nature Conservancy currently lists *Lilium superbum*, the Turk’s-cap Lily, as a G5 plant (W-3), indicating that the species is fully secure worldwide. In the United States, overall, the species is given the National Heritage rank of NNR (nationally not-ranked, for reasons that are unclear, because this species is only found in the United States).

Official protection for this lily outside of Forest Service lands depends upon state and local laws because it is not listed as Federally threatened or endangered. The state rankings vary somewhat. *Lilium superbum* is listed as Endangered in New Hampshire (S1), and as Threatened in Kentucky (S1S2). It has been listed as Critically Imperiled (S1) in Arkansas, Florida, Louisiana, and Missouri, and it is listed as a species that is Exploitably Vulnerable in New York. It is considered Imperiled (S2) in Alabama and Illinois and Vulnerable (S3) in Indiana, Mississippi and Ohio and slightly less so in Georgia (S3S4). It is at risk at the margins of its range. While previously listed as Endangered in Illinois (Herkert 1991), this species is not currently protected in Illinois. Likewise, the Turk’s-cap Lily has been found to be too common to track in Indiana (Homoya, pers. comm.), though it is included on the Indiana Watch List (Yatskievych 2000).

In Forest Service Region 9, the Turk’s-cap Lily is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest but not the Hoosier National Forest, where it appears to be more common (W-5; Shawnee National Forest 2005).

Table 1 lists the official state rank for *Lilium superbum* assigned by each state’s Natural Heritage program according to the Nature Conservancy at their Internet site (W-3). Appendix 3 explains the meanings of the acronyms used (W-6).

A summary of the current official protection status for *Lilium superbum* follows:

<u>U.S. Fish and Wildlife Service:</u>	Not listed (None)
<u>U.S. Forest Service:</u>	Listed as at risk in the Shawnee National Forest only, Region 9

Global Heritage Status Rank: G5

U.S. National Heritage Status Rank: NNR

Table 1: S-ranks for *Lilium superbum* [Heritage Element Code: PMLIL1A0P0]

State/Province	Heritage S-rank	Minnesota	SNR
UNITED STATES		Mississippi	S3
		Missouri	S1
		New Hampshire	S1 [Endangered]
Alabama	S2	New Jersey	S4
Arkansas	S1	New York	SNR [Exploitably Vulnerable]
Connecticut	SNR		
Delaware	S5	North Carolina	S4
District of Columbia	SNR	Ohio	S3 [Potentially Threatened]
Florida	S1 [Endangered]		
Georgia	S3S4	Pennsylvania	SNR
Illinois	S2	Rhode Island	SNR
Indiana	S3	South Carolina	SNR
Kentucky	S1S2 [Threatened]	Tennessee	SNR
Louisiana	S1	Virginia	SNR
Maryland	SNR	West Virginia	S5
Massachusetts	SNR		

LIFE HISTORY

Lilium superbum is a somewhat fleshy, erect perennial herb. Its flowers are very showy and are visible from rather long distances, and it is a very ornamental plant, sometimes grown in gardens. *Lilium superbum* is pollinated primarily by the swallowtail butterflies that are common within its range, including the Spicebush swallowtail (*Papilio troilus*), the Pipevine swallowtail (*Battus philenor*), and the Eastern tiger swallowtail (*Papilio glaucus*). Great spangled fritillaries also visit the Turk's-cap Lily (Adams and Dress 1982; Skinner 2002). It is also known that bees of various types gather pollen from the native lilies and probably also contribute towards pollination in this species. Most lilies are largely self-incompatible and cross-pollination is required for seed set. In addition, the stamens usually shed their pollen before the stigma elongates and is receptive. Nectar is produced and attracts both butterflies and hummingbirds. *Lilium superbum* is said by some to hybridize with *Lilium canadense* but it does not seem to cross with other species (W-7).

Numerous seeds can be produced as a result of a single pollination event (usually more than 100

per capsule) and plants usually propagate by seed. The Turk's-cap Lily flowers in 4 - 7 years from seed (W-7). The seeds demonstrate a delayed hypogeal germination and the embryos are not fully developed when the seeds are shed. When ripe, the seeds fall on cool, shady, moist ground and germinate in the late spring. They require a warm/cold/warm cycle of stratification, each period being about 2 months long (W-7). The percentage of seed success in the wild is not well known, however. The seedling leaves closely resemble grass leaves, as they are also monocots, and the seedlings usually exhibit only a single leaf for 2 or 3 years, though the leaf becomes larger each year. The plants are also known to propagate vegetatively by means of bulbs, which are actually radially asymmetrical, slowly growing, scaly rhizomes (underground stems). *Lilium superbum* is one of the very few members of the genus that has branching rhizomatous bulbs that contribute towards vegetative reproduction of the species (Skinner 2002).

The plant is edible and deer, rabbits, and slugs often damage it in early spring. If the shoot tip is eaten out the bulb will not grow in that year and will lose vigor (W-7).

Turk's-cap Lily flowers in July and early August. In the southern portion of its range (Alabama) flowers can be found as early as 19 June, and in the extreme northern portions of its range (Massachusetts) flowering can occur as late as 20-25 August. Most flowering occurs from 15 July – 15 August throughout its range.

Fruits are normally ripe in September, and mature fruits can be found from September 3 – September 20 in most areas. In some areas, mature fruits can be found into early October. Soon after pollination, the pedicel becomes erect as the fruit develops, and the fruit remains erect until maturity. The stalks are not very durable and they are generally not visible into the next growing season (pers. obs.). The height of the plants makes it possible for the seeds to be shaken or blown from the capsules for several meters distance. It is uncertain if they are also dispersed by water.

It is rather well known that individuals growing in shade in forests remain sterile and short (Dishong 1996; Shawnee National Forest 2005). For this reason, the Turk's-cap Lily is often overlooked during floristic inventories because the sterile plants can be confused with immature forms of other genera such as *Medeola*, *Isotria*, or even *Trillium*.

POPULATION BIOLOGY AND VIABILITY

Lilium superbum regularly flowers and fruits throughout its range and it has no known reproductive problems, but in order to accomplish this the plant normally requires near or full sun conditions. Those populations growing underneath a tree canopy rarely, if ever, flower, and may remain in an area in the sterile condition for many years (Dishong 1996). In addition, this herb grows in widely scattered and often isolated forest sites at the margins of its range and there appears to be very little interaction (pollen dispersal or seed exchange) with other populations of the same species in those areas, partly because of the fact that flowering has been suppressed in shaded populations. Populations of the Turk's-cap Lily may persist at a site and remain viable

for many years in the reduced, vegetative form and the number of individuals may actually increase by means of vegetative reproduction (see previous section).

It is generally understood by botanists that fertility is normally reduced in inbred populations through the process of autogamy (self-fertilization). Autogamy is useful to the plant when there are small numbers of individuals per area, since the safeguarding of the success of propagation is more important than the production of new genotypes. *Lilium superbum* generally avoids the possibility of inbreeding because the individual plants are self-incompatible, preventing self-pollination. Individuals in such a population can, however, be very closely related, and can even be progeny from a single introduction event, and so they can possess little genetic variability. Fertilization by siblings is the most likely outcome in such cases because there is almost no chance of fertilization by other genotypes unless they are within dispersal range. The populations of this herb in Illinois are isolated from one another and from those in other states. In theory, continued fertilization within a group of closely related individuals can result in severe reproductive problems in these few isolated populations, and successful seed production as well as the genetic variation that allows competition with other species may be compromised (W-8).

An example of negative effects thought to have arisen through isolation of populations can be seen in the case of another monocot, Ofer Hollow Reedgrass (*Calamagrostis porteri* ssp. *insperata* (Swallen) C.W.Greene), which has become isolated on rather dry sandstone bluffs throughout its range. This grass almost never produces viable seed anywhere in its range and this reproductive failure may be a reflection of a high genetic load that has occurred as a result of its long isolation (see Hill 2003). High genetic load can be seen in dominant mutations that result in factors lethal to embryos, and this situation appeared to be indicated in that grass. That plant survives as a rare relict in the vegetative state only. There is no data at this time on the fertility of *Lilium superbum* seeds produced in the Illinois and Indiana populations. While it is a vulnerable species in the Midwest, the Turk's-cap Lily does appear to be secure in other areas with suitable habitat remaining. Whether it persists or not in the future in areas where it is currently scarce appears to depend on the survival and maintenance of its habitat.

POTENTIAL THREATS

Globally, the Turk's-cap Lily is considered to be secure (see Protection Status above). In some portions of the United States, however, the species is critically imperiled to imperiled, as in Alabama, Arkansas, Florida, Illinois, Kentucky, Louisiana, Missouri, and New Hampshire. It is most at risk at the margins of its range. Known threats to *Lilium superbum* include habitat loss as a result of human activities, habitat degradation from shading and natural succession, competition from invasive species, deer herbivory, over-collecting, and all-terrain vehicle (ATV) damage (W-9; Shawnee National Forest 2005).

Throughout its range, populations appear to have been eliminated by human activities. It is well known that many acres of wetlands have been lost through draining and landfill activities for

agricultural use as well as for construction of various kinds. This is especially true in highly desired locations along the coast in New England and in high elevation areas in the Appalachians (pers. obs.). The habitat for this species is especially sensitive to changes in hydrology and not likely to withstand much alteration (W-9). Grazing or browsing pressure (this being an edible plant to livestock and wildlife), certain types of vegetation removal, and hydrologic changes (*i.e.* stream alterations road construction) would be detrimental. Soil disturbance resulting from activities such as ATV trails (causing the destruction of plants and habitat), unmanaged timber removal or any activity that results in increased erosion and weed invasion also will be detrimental (W-9). When these activities take place in wet weather, environmental degradation generally increases exponentially. Certainly road construction and mining or quarrying activities can also eliminate entire populations of the species.

Because *Lilium superbum* requires fairly open surroundings in order to flower, the increase in vegetation density that often follows human disturbance (such as the intensive logging of mature forests) may also threaten populations. This is a delicate balance, because it is also well known that this lily thrives immediately after forest clearing. As previously mentioned, according to personnel at the Shawnee National Forest (2005), 51 flowering individuals and 147 juveniles appeared in a 200 square meter area where a clear cut took place on private property during June 1991. However, subsequent aggressive vegetation growth in such clearings can reverse these gains. The use of fire management has been shown to have positive effects on this species, as at Simpson Township Barrens and Fink Sandstone Barrens within Shawnee National Forest (2005). Therefore, some human intervention can be beneficial in the form of fire management. *Lilium superbum* often occurs along trails in forests, and trampling and erosion along the trails by humans and horses is a potential threat. This must be weighed against the potential benefits to the plant provided by a more open canopy. Selective opening of the canopy can be a benefit, while subsequent grazing, soil erosion and trampling cannot.

Natural forest maturation, or the natural closure of the forest canopy, also threatens the Turk's-cap Lily. It has been shown that the species will not reproduce well under low light conditions as seen in a mature forest with a closed canopy (Dishong 1996). Openings, such as those caused by tree fall or fire, as well as those naturally occurring near streams and outcrops, tend to produce more flowering and seed production in this species (Shawnee National Forest 2005). As the forest canopy closes, however, fewer individuals flower and eventually the population no longer flowers and fruits. Hand removal of trees in the vicinity of the species is necessary under these circumstances (W-9).

Competition from invasive species is known at sites where *Lilium superbum* occurs (W-9). The species is potentially threatened by woody plant invasion and by *Lonicera* spp. and Multiflora rose (*Rosa multiflora*) in particular. Other aggressive exotics in the southern portions of its range, such as kudzu (*Pueraria lobata*) and wisteria (*Wisteria sinensis*) can also engulf and eliminate the Turk's-cap Lily. In Illinois, it is thought that the Japanese honeysuckle (*Lonicera japonica*) can become a serious threat to this herb (Shawnee National Forest 2005). Woody plant

invasion may need to be controlled using periodic prescribed fire, mowing or other means to maintain the open character of the habitat for this species. The exotic pest plants are a threat to this species and should be removed. (W-9). Agricultural nutrient runoff from croplands can increase the frequency of the aggressive exotic weeds that compete with the Turk's-cap Lily and other native species.

The destructive effects of herbivory on *Lilium superbum* by various animals, especially deer, have been discussed in the literature (USDA / APHIS / Wildlife Services 2001; Fletcher *et al.* 2001; W-9). Fletcher *et al.* (2001) studied predation on the Turk's-cap Lily by rodents and deer in Virginia. The rodents (*Peromyscus leucopus*, *Sciurus* sp., and *Tamias striatus*) dug up and consumed 9% of all the bulbs planted in the study, and fatal rodent damage was 3 times greater in successional than in upland hardwood and creek bottom habitats. White-tailed deer (*Odocoileus virginianus*) consumed the apical meristem of 28% of the unprotected lilies that emerged, reducing mean plant height and stopping growth and reproduction for that season. Deer and insects, but not rodents, damaged a greater proportion of plants emerging in small patches (1-2 plants/0.04 ha) than on larger patches (3-20 plants/0.04 ha). The consumption of the buds and flowers is often the case for other species of lilies and orchids as well. Therefore, when protecting remaining populations or restoring new populations of rare perennial wildflowers in the eastern deciduous forest, methods for protecting plants from herbivory by rodents and white-tailed deer should be considered. Deer often use existing footpaths for travel through forested terrain, and, conversely, many footpaths have begun as deer trails, so that the chances for deer to encounter *Lilium superbum* plants that grow near trails may be greater even if the deer population is not locally large. This may suggest that the creation of trails in the vicinity of a Turk's-cap Lily population may increase damage to these plants by deer. Some insect herbivory on leaves has also been noted. Rabbits and slugs eat the plant in early spring when these animals readily consume the tender new growth of these lilies. If the shoot tip is eaten out the bulb will not grow in that year and will lose vigor (W-7).

There is a new threat that may yet reach the Turk's-cap Lily in the United States, though it seems to be confined to New England and Canada for now, namely, the exotic Red Asian Lily Beetle (also known as the Asiatic Lily Beetle, or the Lily Leaf Beetle, *Lilioceris lili*), which has struck both cultivated and wild populations of lilies in Quebec and in the Ottawa area (W-10). This insect could become devastating to our native lilies and it has already become a serious problem where it has already become established (W-11).

The showy nature and relatively easy cultivation of the Turk's-cap Lily and some related species has resulted in the loss of populations from over-collection (Skinner 2002, W-9). The lilies have also been gathered for food. Historically, the bulbs have been used like potatoes as a food or as a thickener in soups, and it has a starchy and slightly sweet taste (W-7). Collection of the bulbs from the wild destroys the plant. There are many Internet sites that indicate and detail how this species can be propagated from seeds, and quite a few wildflower nurseries also sell the plant, so collection from small populations should most certainly be avoided (Skinner 2002).

As stated in the previous section on Population Biology and Viability, it is generally believed among biologists that habitat fragmentation can also have profound effects on the success and persistence of small local populations through a process known as inbreeding depression. According to the study by Fletcher *et al.* (2001), current land-use changes in eastern deciduous forests, such as fragmentation, may affect population sizes of native wildlife that may exacerbate declines in rare and endangered wildflower populations in the eastern deciduous forests. Over time, as populations become increasingly more isolated, the effects of fragmentation can potentially be observed at the molecular level by reduced genetic frequencies caused by random drift (Barrett and Kohn 1991). When one is considering populations that are already isolated, as in the case of the Illinois, Indiana, and Missouri populations of this plant, random genetic drift may have already occurred and this may have caused negative effects to the species. This genetic drift may cause the individuals to be less adaptive to competition and environmental change.

At the current time, however, *Lilium superbum* appears to be secure within the Shawnee National Forest (Shawnee National Forest 2005).

RESEARCH AND MONITORING

The Turk's-cap Lily has been the subject of study in several parts of its range. In Illinois, recent studies by Dishong, Shimp and others (Dishong 1996; Shawnee National Forest 2005) have greatly increased the understanding of the species as it occurs in this region. *Lilium superbum* was removed from consideration as an endangered plant in Illinois based, to a large part, on these recent studies and observations. Several basic research needs are still called for, including the continued examination of the widely scattered herbarium specimens of this lily to determine its current and historical range throughout the Midwest region. We now have a better concept of its distinguishing features even on sterile specimens. Fieldwork is an integral part of continued research and monitoring and can be concurrent, and new populations may continue to be found as well. Because *Lilium superbum* does not flower in shaded situations and because the sterile plants are more difficult to notice in the wild, additional populations may actually be present in Illinois and Indiana, and elsewhere, as Shimp and others already have clearly demonstrated. Some training may be required to allow the recognition of this plant in its vegetative state. Unless one has become quite familiar with populations of this plant, the young or sterile plants can be easily mistaken for other similar species, especially in the single-leaf stage (Hill, pers. obs.).

A significant amount of information is known concerning the life history of the plant but a few specific details are not known for the local populations in Illinois and Indiana, especially concerning fertility, dispersal mechanisms, early establishment requirements, growth rates, and genetic health (including variability). Studies conducted on somewhat related species, such as *Chamaelirium luteum* populations in New England, New York, and North Carolina can suggest

both methodology and the primary areas of interest (see Allard 2003).

Annual or periodic monitoring of existing populations of the Turk's-cap Lily may be essential to the local survival of this species. In parts of its range, both in areas where it is declining and in areas where it is still common, periodic monitoring is needed not only to supply data on the life history of this herb, but also to evaluate the threats to its habitat caused by habitat degradation or destruction, and from threats by exotic species. The potential threats from foraging native and domestic animals and from new insect pests should not be underestimated. Population stability, reproduction, and vigor should all be monitored. The searches for additional populations are always needed to re-evaluate the plant's status. While hydrology and humidity fluctuations are assumed to occur in its habitat, it is not known precisely how much fluctuation can occur without adversely affecting the plants and additional research is needed in this area. It is also not known how well this herb can be established in newly opened forest sites, though it is probable that it could be successfully introduced to such sites based upon current knowledge of its habitat preferences. It is not known exactly how much disturbance can occur before an individual population is adversely affected, nor is it known precisely how large an open habitat is needed to support a viable population. In particular, research on the use of fire management, already shown to have promising results, would be useful towards the understanding and preservation of the Turk's-cap Lily in our area. The periodicity and optimum seasonality of such fires is incompletely known.

Monitoring of the forests where it still occurs or where it has been introduced may assist in determining what the local environmental parameters should be for optimal health for this lily. Where it still occurs, periodic surveys are needed to determine the basic health and productivity of the population by periodically counting the numbers of individuals. This is the only means to determine population trends accurately (W-3). Reproductive success can be estimated by counting the number of fruiting stems produced each season because seedlings and young plants cannot always be easily identified in the field. As part of the basic research on current populations of this species, data such as counts of numbers of individuals present (or the area covered by the colony), the determination of the amount of yearly flowering and seed production that might occur, and an assessment of recruitment rates are needed in order to monitor population dynamics and to assess the viability of the individual populations found. Individual plants should be monitored over a growing season at each site for basic phenology data. Such basic facts as fungal associations (if any), longevity, and yearly variations in colony size over a long period are not precisely known for populations in Illinois and Indiana.

Once new populations are found, voucher specimens should be made according to techniques described in Hill (1995) or other similar references. Similar habitat should be explored for the plant at its flowering and fruiting seasons. Particular attention should be made to search for and / or monitor this herb at its peak period for flowering in one's local area, normally in mid July to early August when the showy flowers are most visible. There are rather large areas of additional suitable habitat in southern Illinois where the Turk's-cap Lily could also exist. A list of typical

associates and indicator species has been compiled as a result of field studies in other states (see Habitat section above) and many of these should also occur with the species in Illinois. These indicator plants can be very useful in facilitating the discovery of additional populations of this herb. It is quite possible that populations of this species either have been overlooked because of difficulties in field identification of sterile plants or because of the lack of adequate voucher material.

Botanical surveys conducted by scientists from the Illinois Natural History Survey and elsewhere have shown repeatedly that with sufficient time and funding, and an experienced eye, many plants thought to be extirpated or else threatened or endangered occasionally can be found at additional locations (Hill 2002). These sorts of investigations have been important in that they have led not only to the de-listing of species once thought to be rare, but they have also resulted in the discovery of species previously unknown in the state. The U.S.D.A. Forest Service and other related agencies have done a fine job in the effort to preserve rare species with the resources that they have available. Much of the locating and monitoring of known populations of rare species in southern Illinois has been conducted by Forest Service biologists, consultants, and students in cooperation with Illinois Department of Natural Resources personnel. However, a continuing problem is that there is neither sufficient funding nor are there enough botanists available to survey the immense area that needs to be covered in the monitoring of the large numbers of sensitive plants, including this one. It appears that a high priority should be given to the training and hiring of more qualified field botanists to achieve these goals.

RESTORATION

Restoration efforts by means of prescribed burns are being conducted on *Lilium superbum* in Illinois (Shawnee National Forest 2005), and the restoration potential of this and similar species may be good. Fruit production in this species appears to be dependable when conditions in its habitat are suitable, and the prescribed burns appear to be of great benefit to reproduction in this species. The species, while widely distributed, is generally not common in the midwestern states and there appears to be a significant amount of habitat available where restoration efforts can also occur in southern Illinois. Its habitat also can be created in some otherwise suitable areas, if necessary, through selective thinning of trees and by fire management. It may be necessary to purchase private land already dedicated to other uses that has had historic populations of the species on it and to restore the habitat on this land for this plant. At this time, however, data suggests that the priority activity to encourage the persistence of reproductive colonies of this lily should be carefully scheduled and monitored prescribed burns (Shawnee National Forest 2005).

In order to restore this species to areas where it may have historically occurred, it is generally thought that the habitat itself must be restored (W-3); this is the generally recommended method to manage populations of this and other rare plants, *i.e.*, to protect and manage their habitat. Protection of the hydrology, topography, and exposure within and near the sites is crucial, and natural fire regimes are to be allowed. Added fire management has been shown to be beneficial

for this plant. The specific effects of herbicides on this broad-leaved herb are thought to be generally harmful, so herbicides are not yet recommended in the management program without additional study. The control of exotic species threatening a given population, then, should also seek alternative solutions if they cannot be managed by fire alone.

As also described in the previous section of this report, it is generally recommended that the habitat quality where this and other rare plants grow should be monitored on a regular basis and an assessment of the specific threats to all populations should be made (W-3). Successful management or restoration of the Turk's-cap Lily depends on periodic surveys of both the environment in which it grows as well as the monitoring of population sizes and individual plants. Nearby land use should be noted – as in the case of the conversion of areas to tree plantations and other crop – and the chemical and hydrologic effects on adjacent vegetation, as well as the appearance of new trails or road construction should also be noted. While many herbicides are thought to be detrimental, so are fertilizers, which, in this habitat, can cause an increase of native and exotic invasives that can crowd out the *Lilium* and other scarce natives adapted to these often nutrient-poor, somewhat acidic soils.

True restorations of any native plant species are recommended using only propagated material grown from native, local populations to avoid mixing genotypes not adapted to the local conditions and to avoid compromising the local gene pool. If this rule is not followed, the result is generally the loss of plants because they are not competitive under local conditions, or the result could be the success of a plant or plants that cannot be considered truly native (a plant community *reconstruction* rather than a restoration). Local plants should be propagated for planting in such an effort. Most perennial herbs are normally easily propagated by means of seeds, though the occurrence of some plants with branched rhizomes, such as the Turk's-cap Lily, may allow some vegetative propagation. According to at least one Internet site (W-7), the plants propagated in cultivation will require regular feeding when in growth. Divide the young bulbs when they are dormant, putting 2 - 3 in each pot, and grow them for at least another year before planting them out into their permanent positions when the plants are dormant. The bulbs should be planted 12 – 20 cm deep. Division with care can take place in the autumn once the leaves have died down, and the bulbs should be replanted immediately (W-7). In addition, bulb scales can be removed from the bulbs in early autumn. If they are kept in a warm dark place in a bag of moist peat, they will produce bulblets. These bulblets can be potted up and grown in the greenhouse until they are large enough to plant out (W-7). The Turk's-cap Lily prefers an open free-draining humus-rich loamy soil with its roots in the shade and its head in the sun, and it requires a lime-free soil (W-7).

The propagated plants can be used to enhance an already existing small population or to attempt the creation of a new population. Records of all such introductions should be maintained where they can be easily referenced.

It is not known what the minimum population size should be for the viability of this species in

the wild. It is known that in Illinois population sizes can vary from 19 to over 1,000 individuals (Dishong 1996) but it is not known if all of these populations are sufficiently large for long term persistence. Several sources have useful information that may be of assistance in this area (Allard 2003, Given 1994, Menges 1991, Shaffer 1987).

The Turk's-cap Lily is available commercially from several nurseries, normally as plants, because of its ornamental qualities. As previously mentioned, because of the desirability of this wild native plant for ornamental gardens the plant has become increasingly uncommon in much of its range as a consequence of over-collecting.

SUMMARY

The Turk's-cap Lily, *Lilium superbum* L., is a perennial herb from a rhizomatous bulb with a single stem about 1.2-2 meters tall with whorled narrowly-elliptic leaves, and showy red-orange pendent terminal flowers. The species is very ornamental and it is widespread in the eastern United States, and it is known historically from twenty-six states including the District of Columbia, from New Hampshire west to Illinois and Missouri, south to Louisiana and Florida. It is a species often associated with wetlands or the margins of mesic upland forests and it grows in soils that are often acidic. Globally, its ranking is G5 (secure world-wide); its National status in the United States is NNR (not ranked nationally). The Turk's-cap Lily is listed as Endangered in New Hampshire (S1), and as Threatened in Kentucky (S1S2). It has been listed as Critically Imperiled (S1) in Arkansas, Florida, Louisiana, and Missouri, and it is listed as a species that is Exploitably Vulnerable in New York. It is considered Imperiled (S2) in Alabama and Illinois and Vulnerable (S3) in Indiana, Mississippi and Ohio and slightly less so in Georgia (S3S4). In Forest Service Region 9, the Turk's-cap Lily is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest but not the Hoosier National Forest. It is at risk at the margins of its range.

Suggested research priorities for this local, rare herb in the Midwest include attempts to locate additional populations, studies to determine more precisely the periodicity and the best management techniques to insure its survival and increase (such as controlled use of fire and the selective thinning of canopy trees to open the habitat), studies to determine the genetic diversity of the populations, and studies to determine a means to increase the numbers of individuals within the local populations.

The suggested priorities to allow the persistence of the extant colonies of *Lilium superbum* is generally to preserve and manage their habitats by means of the protection of current hydrology (including erosion control), through protection from land development, by protection from indiscriminate or nearby herbicide or fertilizer application, by protection from soil disturbance and physical damage to the plants and habitat by vehicles, animals, and people (including harvesting), and by protection of the habitat from the establishment of invasive or predatory species. Fire management appears to be very beneficial and management by prescribed

fires and canopy clearing along with the preservation of the existing site hydrology appear to be necessary to allow it to persist where it may occur. Because of its preference for small wetlands, and its ornamental and fragile nature, monitoring of the existing populations is needed to suggest any additional protections that may be necessary. Certainly, the picking of its flowers by people and the foraging by deer and livestock is to be discouraged in order to maintain reproductive populations. At this time, with proper management, the current populations in southern Illinois and Indiana should persist and its long-term chances of survival in these states now appears to be good. The establishment of additional populations will be, most likely, only through active human efforts.

REFERENCES

- Adams, R.M. 1981. A systematic study and monograph of the Turk's cap lilies of eastern North America (with the introduction of some new cultivars). Ph.D. dissertation, Cornell University, Ithaca.
- Adams, R.M. and W.J. Dress. 1982. Nodding *Lilium* species of eastern North America (Liliaceae). *Baileya* 21:165-188.
- Allard, D.J. 2003. *Chamaelirium luteum* (L.) A.Gray, Devil's Bit, Conservation and Research Plan for New England. Prepared for the New England Wild Flower Society, Framingham, MA. 34 pp.
- Barrett, B.C.H. and J.R. Kohn. 1991. Genetic and evolutionary consequences of small population size in plants: implications for conservation. [Pp. 3-30 *In* Genetics and conservation of rare plants, D.A. Falk and K.E. Holtzinger, Eds. Oxford University Press, New York, NY.
- Basinger, M.A. 2002. Notable plant records from Missouri. *Transactions of the Illinois State Academy of Science* 95(4): 247-249.
- Chester, E.W., B.E. Wofford, R. Kral, H.R. DeSelm, and A.M. Evans. 1993. Atlas of Tennessee Vascular Plants. Vol. 1. Pteridophytes, Gymnosperms, Angiosperms: Monocots. Misc. Publ. no. 9, The Center for Field Biology, Austin Peay State University, Clarksville, TN.
- Clewell, A. F. 1985. Guide to the Vascular Plants of the Florida Panhandle. University Presses of Florida, Tallahassee. 605 pp.
- Deam, C.C. 1940. Flora of Indiana. Indiana Department of Conservation - Division of Forestry, Indianapolis. 1236 pp.
- Dishong, D. L. 1996. A review of the taxonomy and a study of the ecological status, of *Lilium*
Conservation Assessment for the Turk's-cap Lily (Lilium superbum L.)

- superbum* L., an endangered species in Illinois. Ph.D. thesis, Department of Plant Biology, Southern Illinois University at Carbondale. xiv, 286 pp, bound.
- Fernald, M. L. 1950. Gray's Manual of Botany. Eighth Edition. Dioscorides Press, Portland, OR.
- Fletcher, J.D., L.A. Shipley, W.J. McShea, and D.L. Shumway. 2001. Wildlife herbivory and rare plants: the effects of white-tailed deer, rodents, and insects on growth and survival of Turk's cap lily. *Biological Conservation* 101(2): 229-238.
- Given, D.R. 1994. Principles and Practice of Plant Conservation. Timber Press, Portland Oregon.
- Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd edition. The New York Botanical Garden, Bronx.
- Godfrey, R. K. and J. W. Wooten. 1981. Aquatic and Wetland Plants of Southeastern United States, Monocotyledons. The University of Georgia Press, Athens, Georgia.
- Harvill, A.M., C.E. Stevens, and D.M.E. Ware. 1977. Atlas of the Virginia Flora, Part 1. Pteridophytes through Monocotyledons. Virginia Botanical Associates, Farmville.
- Haw, S.G. 1986. The Lilies of China. Portland, OR.
- Herkert, J. R. (ed.) 1991. Endangered and Threatened Species of Illinois: Status and Distribution, Volume 1 - Plants. Illinois Endangered Species Protection Board, Springfield, Illinois. 158 pp.
- Hill, S. R. 1995. How to Make a Plant Collection. Herbarium Supply Company, Menlo Park, CA. 8 pp.
- Hill, S.R. 2002. Some recent changes in the Illinois flora. Illinois Natural History Survey Reports. Summer 2002. No. 3722.
- Hill, S.R. 2003. Conservation Assessment for Offer Hollow Reedgrass (*Calamagrostis porteri* A.Gray ssp. *insperata* (Swallen) C.W. Greene). Produced for the USDA Forest Service, Eastern Region, by the Center of Biodiversity, Illinois Natural History Survey, Champaign, 28 April 2003. 30 pp.
- Kartesz, J. T. (data) and C. A. Meacham (software). 1999. Synthesis of the North American Flora. Version 1.0. CD-ROM. Biota of North America Program, North Carolina Botanical Garden, Chapel Hill.

- Magee, D.W. and H.E. Ahles. 1999. Flora of the Northeast. University of Massachusetts Press: Amherst.
- Menges, E.S. 1991. The application of minimum viable population theory to plants. Pp. 45-62 *In* D.E. Falk and K.E. Holsinger (Eds.), Genetics and Conservation of Rare Plants. Center for Plant Conservation. Oxford University Press, New York, New York.
- Mohlenbrock, R. H. 1986. Guide to the Vascular Flora of Illinois. Revised and enlarged edition. Southern Illinois University Press. xii + 507 pp.
- Mohlenbrock, R.H. 2002. Vascular Flora of Illinois. Southern Illinois University Press. Carbondale. 491 pp.
- Mohlenbrock, R.H. and D.M. Ladd. 1978. Distribution of Illinois vascular plants. Southern Illinois University Press. Carbondale. 282 pp.
- Orzell, S.L. and E.L. Bridges. 1987. Further additions and noteworthy collections in the flora of Arkansas, with historical, ecological, and phytogeographical notes. *Phytologia* 64: 81-144.
- Ownbey, G.B. and T. Morley. 1991. Vascular plants of Minnesota – a checklist and atlas. University of Minnesota: Minneapolis. 308 pp.
- Radford, A.E., H.A. Ahles, and C.R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. University of North Carolina Press: Chapel Hill. 1183 pp.
- Reed, P.B., Jr. 1988. National list of plant species that occur in wetlands: national summary. U.S. Fish Wildlife Service Biol. Rep. 88(24).
- Rhoads, A.F. and T.A. Block. 2000. The plants of Pennsylvania: an illustrated manual. University of Pennsylvania Press, Philadelphia. 1061 pp.
- Schwegman, J.E., G.B. Fell, M.D. Hutchinson, G. Paulson, W.M. Shephard, and J. White. 1973. Comprehensive plan for the Illinois Nature Preserve system. Part 2. The natural divisions of Illinois. Illinois Nature Preserves Commission, Rockford. 32 pp.
- Seymour, F.C. 1969. The Flora of New England. The Charles E. Tuttle Company, Rutland, VT. 596 pp.
- Shaffer, M. 1987. Minimum viable populations: coping with uncertainty. Pp. 69-86 *in* M.E. Soulé (ed.), Viable Populations for Conservation. Cambridge University Press, Cambridge, UK.

- Shawnee National Forest. 2005. Shawnee National Forest biological evaluation of Regional Forester's Sensitive plant species. Forest Plan Revisions. Shawnee National Forest. Harrisburg, Illinois. Available at:
http://www.fs.fed.us/r9/forests/shawnee/projects/forest_plan_revision/documents/plant-be.pdf
- Skinner, M.W. 2002. *Lilium* Linnaeus, Sp. Pl. 1: 302. 1753; Gen. Pl. ed. 5, 143. 1754. Pp. 172-197. In Flora of North America Editorial Committee. 2002. Flora of North America North of Mexico. Volume 26 Magnoliophyta: Liliidae: Liliales and Orchidales. New York: Oxford University Press. 723 pp.
- Smith, E.B. 1978. An Atlas and Annotated List of the Vascular Plants of Arkansas, 2nd printing 1979. University of Arkansas Bookstore, Fayetteville. 592 pp. + addenda.
- Strausbaugh, P. D. and E. L. Core. 1978. Flora of West Virginia. Second Edition. Seneca Books, Inc., Grantsville, West Virginia.
- USDA / APHIS / Wildlife Services. 2001. Environmental Assessment for cervid damage management in Kentucky. Wildlife Services District Office, Louisville, Kentucky. 54 pp.
- Wofford, B. E. 1989. Guide to the Vascular Plants of the Blue Ridge. University of Georgia Press, Athens, Georgia.
- Yatskievych, G. 1999. Steyermark's Flora of Missouri. Vol. 1. The Missouri Botanical Garden Press: St. Louis. 991 pp.
- Yatskievych, K. 2000. Field Guide to Indiana Wildflowers. Indiana University Press: Bloomington. 357 pp.

WEBSITES CONSULTED

- W-1. U.S.D.A., NRCS. 2006. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
http://plants.usda.gov/cgi_bin/topics.cgi
- W-2. National Wetlands Inventory. U.S. Fish and Wildlife Service, Washington, DC.
<http://www.fws.gov/nwi/>
- W-3. NatureServe Explorer (The Nature Conservancy): An online encyclopedia of life. 2006. Version 1.6. Arlington, Virginia, USA.
<http://www.natureserve.org/>

- W-4. National Vegetation Classification – Southeastern United States. April 1999.
<http://biology.usgs.gov/npsveg/grsm/elcode.pdf>
- W-5. U.S.D.A. Forest Service, Region 9, Regional Forester Sensitive Plants, Signed by Regional Forester 29 February 2000. List maintenance on 20 October 2003.
http://www.fs.fed.us/r9/wildlife/tes/docs/rfss_plants.pdf
- W-6. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia.
<http://www.natureserve.org/explorer/ranking.htm>
- W-7. Plants for a Future. Edible, Medicinal, and useful plants for a healthier world.
http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Lilium+superbum
<http://www.pfaf.org/index.html>
- W-8. Botany On-line - Reproductive Isolation. University of Hamburg, Germany.
<http://www.biologie.uni-hamburg.de/b-online/e38/38d.htm>
- W-9. Kentucky State Nature Preserves Commission, Rare Plant Database, *Lilium superbum*.
<http://eppcapps.ky.gov/nprareplants/details.aspx?species=Lilium+superbum>
- W-10. North American Native Plant Society: Native Lilies at the Old Field Garden, by Philip Fry
<http://www.nanps.org/featuredplants.aspx?article=lilies.html>
- W-11. Extension Service, University of Massachusetts, Amherst. Fact Sheet for Lily Leaf Beetle.
http://www.umassgreeninfo.org/fact_sheets/defoliators/lily_leaf_beetle.html

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APPENDIX 1

Representative specimens of *Lilium superbum* examined or cited in the literature

Herbaria:

CLEMS = Clemson University, Clemson, South Carolina. ILLS = Illinois Natural History Survey, Champaign. MO = Missouri Botanical Garden, St. Louis. NCU = University of North Carolina, Chapel Hill. UNAF = University of Alabama at Florence. VT = University of Vermont, Burlington. WIS = University of Wisconsin, Madison.

ALABAMA: HENRY CO., ca. 3 mi W of Fort Gaines, GA, 30 Jul 1972, *Kral 47936* (MO); **LAWRENCE CO.**, County Road 193, 19 Jun 1992, *Smith s.n.* (UNAF); **PICKENS CO.**, ca. 2 mi N of Aliceville by AL 17, 13 Jul 1969, *Kral 35516* (MO).

CONNECTICUT: NEW LONDON CO., Latimer Point, Stonington, 8 Aug 1971, *Hill 788* (VT); Rt. 49, between Voluntown and North Stonington, 3 Aug 1988, *Hill 19723* (CLEMS, MO, VT).

DELAWARE: NEW CASTLE CO., Wilmington, s.d., *Canby s.n.* (WIS); **SUSSEX CO.**, Ruthly, 1 Aug 1897, *Commons s.n.* (MO).

DISTRICT OF COLUMBIA: Takoma, 23 Jul 1904, *Dowell 3017* (MO); Washington, 25 Aug 1896, *Steele 85* (MO).

GEORGIA: RANDOLPH CO., along branch about 2 mi E of Cuthbert, 20 July 1903, *Harper 1893* (MO); **SUMTER CO.**, in SE part of county, 25 July 1901, *Harper 1117* (MO).

ILLINOIS: POPE CO., Jackson Hollow Natural Area, Shawnee National Forest, 27 Jun 1986, *Smith 1019* (ILLS); **UNION CO.**, below Allen's Flat, Pine Hills region east of Larue, 1 May 1955, *Buser 3949* (WIS); **WILLIAMSON CO.**, Crab Orchard National Wildlife Refuge, 26 Aug 1984, *Ulaszek 827* (ILLS).

KENTUCKY: HARLAN CO., top of Black Mountain, 28 Jul 1949, *McFarland 56* (WIS).

MARYLAND: GARRETT CO., Mountain Lake and vicinity, 7 Sep 1921, *Steele 183* (MO); **HARFORD CO.**, Hokes's 2nd Cove, 2.5 mi SSW of Havre de Grace, 24 Jul 1902, *Shull 101* (MO).

MASSACHUSETTS: BARNSTABLE CO., Dennis, 7 Aug 1917, *Churchill 288* (MO); **BRISTOL CO.**, Rehoboth, 22 Jul 1955, *Seymour 16173* (MO; WIS); Dighton, Center Street, 25 Jul 1961, *Seymour s.n.* (MO); along Taunton River, Taunton, 17 Sep 1957, *Seymour 17744* (MO); Attleboro, 6 Aug 1897, *Churchill s.n.* (MO); New Bedford, s.d., *Greene s.n.* (WIS); **PLYMOUTH CO.**, E. Wareham, 20 Aug 1888, *Churchill s.n.* (MO); Wareham, 3 Sep 1894, *Churchill s.n.* (MO); Mattapoisett, 18 Jul 1890, *Wislizenius 1010* (MO).

MISSISSIPPI: CALHOUN CO., ca. 7 mi W of Calhoun City, N of MS Hwy 8, 7 Jul 1988, *Bryson*
Conservation Assessment for the Turk's-cap Lily (Lilium superbum L.) 30

8210 (MO).

MISSOURI: BOLLINGER CO., Sweetgum Public Access Area near Cypress Pond, 6 Jul 2001, *Brant* 4726 (MO); **CAPE GIRARDEAU CO.**, N of Otahki Memorial at Trail of Tears State Park off MO 177, 6 Jul 2000, *Basinger* 12337 (MO).

NEW JERSEY: ATLANTIC CO., Rt. 563, south side of Mullica River north of Weekstown, 9 Aug 1987, *Hill* 18531 (CLEMS); **BERGEN CO.**, head of Overpeck Creek, Englewood, 12 Aug 1932, *Leiderman* 47 (WIS); **BURLINGTON CO.**, W of Rancocas Creek, New Lisbon, 26 Jul 1889, *MacElwee* 952 (MO); **GLOUCESTER CO.**, Tomlins, 9 Sep 1911, *Williamson s.n.*, (WIS); **OCEAN CO.**, Barnegal Pier, Sep 1907, *Mackenzie* 2881 (MO).

NEW YORK: SUFFOLK CO., River Head, Long Island, 11 Aug 1873, *Miller s.n.* (MO).

NORTH CAROLINA: BUNCOMBE CO., Biltmore Estate, Jul 1891, *Biltmore Herbarium* 2651b (MO); **CALDWELL CO.**, southern slopes of Grandfather Mountain, 25 Jul 1891, *Small & Heller* 327 (MO); **SWAIN CO.**, Hyatt Ridge Trail, Great Smoky Mountains National Park, 30 Jul 1999, *Philippe* 31170 (ILLS); **YANCEY CO.**, on N.C. 197 near Little Cane River Gap, 23 Jul 1966, *Radford* 45052 (NCU, UNAF, WIS).

PENNSYLVANIA: BUTLER CO., along Conoquennessing Creek near Renfrew, 17 Jul 1932, *Bright* 6796 (WIS); **LANCASTER CO.**, Rawlinsville, 1884, *Galen s.n.* (MO); **LEBANON CO.**, Penryn, 30 Jul 1894, *Eby s.n.* (MO); open places in the forest at Penryn, 7 Aug 1926, *Heller* 14246 (MO); Quarryville, Jul 1889, *Eby s.n.* (MO).

RHODE ISLAND: KENT CO., Narrow Lane, West Greenwich Center and Hopkins Hollow, near Perry Hill Rd, 12 Aug 1987, *Hill* 18575 (CLEMS, MO, VT); **PROVIDENCE CO.**, Providence, 1878, *Bailey s.n.* (MO).

SOUTH CAROLINA: AIKEN CO., Graniteville, 6 Aug 1898, *Eggert s.n.* (MO).

TENNESSEE: COCKE CO., Cherokee National Forest, 11 Aug 1994, *Miller & Snow* 8358 (MO); **SEVIER CO.**, Clingman's Dome, Aug 1899, *Ferriss s.n.* (MO).

VIRGINIA: AMHERST CO., east of Alto on Salt Log Gap Road, 20 May 1977, *Ramsey, Sherwood & Leys* 26279 (WIS); **BEDFORD CO.**, 20 Jul 1871, *Curtis* 8092 (MO); **GRAYSON CO.**, Mount Rogers, 13 Jul 1978, *Hill* 7487 (VT); **PAGE CO.**, Stony Man Mountain and vicinity in the Blue Ridge near Luray, 5 Sept 1901, *Steele* 86, (MO).

WEST VIRGINIA: POCAHONTAS CO., Drupe Mountain, 30 Jul 1930, *Berkley* 1334 (MO).

APPENDIX 2.

**The Historic Distribution of *Lilium superbum* in the United States.
Information from herbarium specimens and the literature.
(If in > 10 counties, then only number of counties included.)**

STATE	COUNTIES	NOTES
Alabama	At least 12 counties, scattered, not northwestern	(W-1; W-3).
Arkansas	Arkansas, Logan, Madison, Newton, Pope, Stone	(W-1; W-3); Orzell and Bridges (1987); Smith (1978); Yatskievych (1999)
Connecticut	Fairfield, Middlesex, New Haven, New London	(W-1; W-3); Magee and Ahles (1999)
Delaware	Newcastle, Sussex	(W-1; W-3)
District of Columbia	Present	(W-1; W-3)
Florida	Jackson, Jefferson, Leon, Liberty	(W-1; W-3); Clewell (1988)
Georgia	Ben Hill, Douglas, Fannin, Oconee, Pike, Rabun, Union, Upson, Walker, White	(W-1; W-3)
Illinois	Gallatin, Hardin, Jackson, Johnson, Pope, Union, Williamson	(W-1; W-3); Mohlenbrock and Ladd (1978); Mohlenbrock (1986); Shawnee National Forest 2005; includes Shawnee N.F.
Indiana	Brown, Clark, Crawford, Fayette, Greene, Lawrence, Morgan, Washington	(W-1; W-3); Deam (1940)
Kentucky	Calloway, Carlisle, Casey, Hardin, Harlan, Hickman, Letcher, McCracken, McCreary, Warren	(W-1; W-3); Adams (1981)
Louisiana	St. Tammany Parish, Washington Parish	(W-3); Skinner (2002)
Maryland	At least 12 counties	(W-1; W-3); W. Smith (atlas maps, 2006, unpublished)
Massachusetts	Barnstable, Bristol, Nantucket, Plymouth, Suffolk	(W-1; W-3); Magee and Ahles (1999)
Mississippi	At least 18 counties	(W-1; W-3)
Missouri	Bollinger, Cape Girardeau, Crawford, Perry	(W-1; W-3); Yatskievych (1999); Basinger (2002); Herbarium specimens

New Hampshire	Strafford	(W-1; W-3); Magee and Ahles (1999)
New Jersey	12 counties, mostly southern 2/3 of state	(W-1; W-3)
New York	Bronx, Broome, Cattaraugus, Chemung, Kings, Nassau, Richmond, Steuben, Suffolk, Tompkins	(W-1; W-3); Magee and Ahles (1999)
North Carolina	18 counties, primarily in the mountains	(W-1; W-3); Radford <i>et al.</i> (1968); Herbarium specimens
Ohio	Adams, Ashtabula, Coshocton, Cuyahoga, Jackson, Knox, Lake, Pike, Portage, Scioto, Trumbull, Tuscarawas	(W-1; W-3)
Pennsylvania	> 40-50 counties, widespread, few in northeast	(W-1; W-3); Rhoads and Block (2000)
Rhode Island	Every county	(W-1; W-3); Magee and Ahles (1999)
South Carolina	Bamberg	Skinner (2002)
Tennessee	Mountains: Blount, Carter, Cocke, Greene, Johnson, Monroe, Polk, Sevier	(W-1; W-3); Chester <i>et al.</i> (1993).
Virginia	> 45 counties, least common south-central area	(W-1; W-3); Harvill <i>et al.</i> (1977)
West Virginia	18 counties, mostly east-central	(W-1; W-3); Strausbaugh and Core (1978)

APPENDIX 3.

Natural Diversity Database Element Ranking System

Modified from: <http://www.cnpsci.org/html/PlantInfo/Definitions2.htm> [W-6]

Global Ranking (G)

G1

Critically imperiled worldwide. Less than 6 viable elements occurrences (populations for species) OR less than 1,000 individuals OR less than 809.4 hectares (ha) (2,000 acres [ac]) known on the planet.

G2

Imperiled worldwide. 6 to 20 element occurrences OR 809.4 to 4,047 ha (2,000 to 10,000 ac) known on the planet.

G3

Vulnerable worldwide. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac) known on the planet.

G4

Apparently secure worldwide. This rank is clearly more secure than **G3** but factors exist to cause some concern (i.e. there is some threat, or somewhat narrow habitat).

G5

Secure globally. Numerous populations exist and there is no danger overall to the security of the element.

GH

All sites are historic. The element has not been seen for at least 20 years, but suitable habitat still exists.

GX

All sites are extirpated. This element is extinct in the wild.

GXC

Extinct in the wild. Exists only in cultivation.

G1Q

Classification uncertain. The element is very rare, but there is a taxonomic question associated with it.

National Heritage Ranking (N)

The rank of an element (species) can be assigned at the national level. The **N-rank** uses the same suffixes (clarifiers) as the global ranking system above. Rarely the designation **NNR** is used indicating that the species has not been ranked nationally.

Subspecies Level Ranking (T)

Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety.

For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked **G2T1**. The G-rank refers to the whole species range (i.e., *Chorizanthe robusta*, whereas the T-rank refers only to the global condition of var. *hartwegii*. Otherwise, the variations in the clarifiers that can be used match those of the G-rank.

State Ranking (S)

S1

Critically imperiled. Less than 6 element occurrences OR less than 1,000 individuals OR less than 809.4 ha (2,000 ac). **S1.1** = very threatened; **S1.2** = threatened; **S1.3** = no current threats known.

S2

Imperiled. 6 to 20 element occurrences OR 3,000 individuals OR 809.4 to 4,047 ha (2,000 to 10,000 ac). **S2.1** = very threatened; **S2.2** = threatened; **S2.3** = no current threats known.

S3

Vulnerable. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac). **S3.1** = very threatened; **S3.2** = threatened; **S3.3** = no current threats known.

S4

Apparently Secure. This rank is clearly lower than S3 but factors exist to cause some concern (i.e., there is some threat, or somewhat narrow habitat).

S5

Secure. Demonstrably secure to ineradicable in the state.

SH

All state sites are historic; the element has not been seen for at least 20 years, but suitable habitat

still exists. Possibly extirpated.

SNR, SU

Reported to occur in the state. Otherwise not ranked.

SX

All state sites are extirpated; this element is extinct in the wild. Presumed extirpated.

Notes:

1. Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a bird's eye or aerial view when ranking sensitive elements rather than simply counting element occurrences.
2. Uncertainty about the rank of an element is expressed in two major ways: by expressing the rank as a range of values (*e.g.*, **S2S3** means the rank is somewhere between S2 and S3), and by adding a '?' to the rank (*e.g.* S2?). This represents more certainty than S2S3, but less than S2.